1. PROJECT SETTING

1.1 INTRODUCTION

This study was done at the request of the Region III office of the U.S. Environmental Protection Agency (EPA) and was conducted under the joint guidance of that office and the National Coastal Ecosystems Team of the U.S. Fish and Wildlife Service (FWS). The assignment was to conduct an assessment of the potential hydrologic and ecologic functions of eight wetland sites on Chincoteague Island, Virginia. These sites ranged in size from approximately 4 ha to 21 ha. The wetlands included estuarine emergent and scrub/shrub along with palustrine emergent, scrub/shrub, and forested.

The Adamus/Stockwell (1983) assessment technique was specified as the method of choice. In addition, we agreed to provide general descriptions of the eight sites and also comment on the apparent effectiveness of the Adamus/Stockwell technique for assessing these wetlands. These descriptions, assessment results, and comments are contained in this report.

1.2 GEOLOGY

1.2.1 Developmental History

Chincoteague Island is a coastal barrier island of recent geological origin located at 75°22' west longitude and 37°56' north latitude. It is approximately 13.3 km long and 2.8 km wide at its widest point (at Piney Island). Chincoteague was formed 2,000 to 4,000 years ago during the mid-Holocene period, a time of lower but rising sea level and abundant sand supply along the mid-Atlantic coast (Halsey, 1979; Kraft et al., 1979). The island is composed of a series of parallel beach ridges and swales that rise less than three m above sea level.

The ridge-swale system at Chincoteague trends roughly from the southwest to the northeast. The oldest ridges (formed first) lie to the northwest. The continued formation of younger ridges (Figure 1) caused Chincoteague's ancestral barrier island to accrete towards the southeast. Approximately 1,000 years ago the formation of inlets to the north and south gave the present-day shape to the island's shoreline. During early colonial times the tip of Assateague Island grew southward, shielding Chincoteague Island from direct exposure to the Atlantic Ocean (Halsey, 1979; see Figure 1).

1.2.2 Stratigraphy

The shallow geology of Chincoteague Island has not been extensively studied. However, it is likely to be similar to that of other barrier islands of similar age and developmental history. Holocene barrier islands are primarily composed of beds of sand or sand and shell with intervening layers of finer sands, silts and organic materials (Kraft, 1979; Missimer, 1973; Bartberger, 1976). These relatively recent geological formations are usually situated on top of confining layers of compacted peat or beds of clay and silt mixed with sand (Kraft et al., 1979; Bartberger, 1976; Missimer, 1973; Wiegle, 1974). The confining layers underlying barrier islands are usually located six to ten meters below sea level. Figure 2 is a profile view of the stratigraphy of a typical Holocene barrier island.

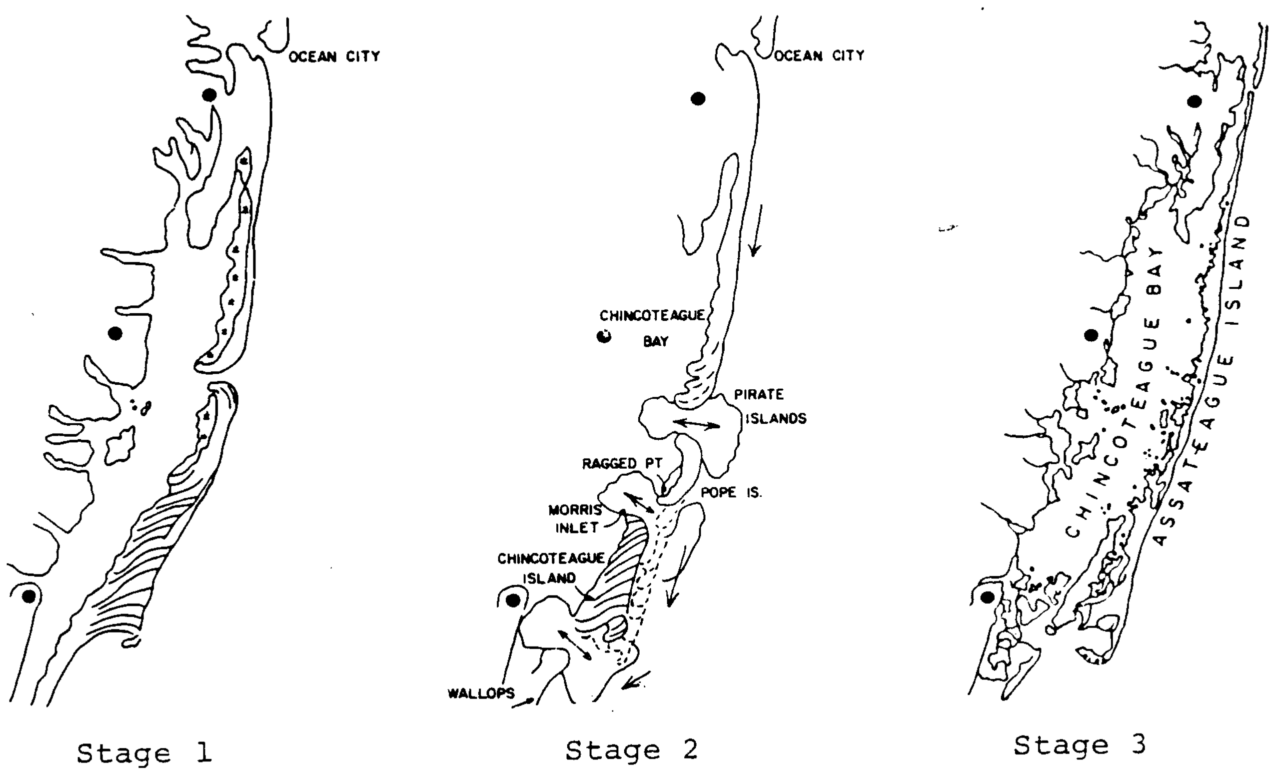

Figure 1. Developmental history of Chincoteague Island (modified from Halsey, 1979).

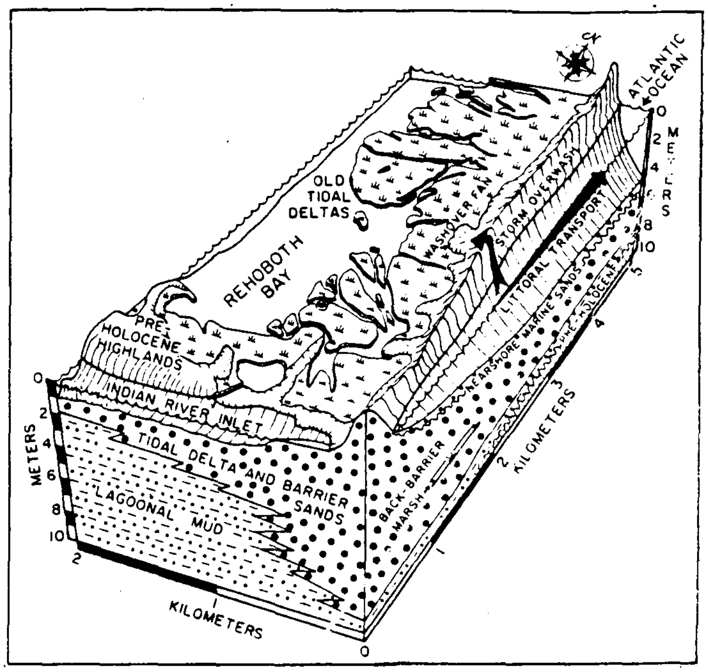

Figure 2. Stratigraphy of a typical Holocene barrier island (from Kraft et al., 1979).

Below the first confining layer at Chincoteague are a series of deep, sandy aquifers and aquicludes which extend downward to the crystalline rock basement which occurs about 7,000 ft below sea level (State Water Control Board, 1975).

1.3 HYDROLOGY

1.3.1 Groundwater

Chincoteague Island is underlain by five or more sandy aquifers enclosed by relatively impervious sediments which function as aquicludes (Department of Agriculture, 1975; Environmental Protection Agency, 1982). Only the two nearest the surface (The Pocomoke and the Manokin) hold appreciable fresh water resources. These aquifers are located between 30 and 90 m below the surface at Chincoteague (Biggs, 1970; State Water Control Board, 1975). Near the surface, the unconfined, water table aquifer may be as much as 6 to 9 m thick before it intersects the first aquiclude. The water reserves of this aquifer are brackish (State Water Control Board, 1975) except for some localized lenses of freshwater that occur above sea level (Grant Goodell - pers. comm.). Unlike the Pocomoke and Manokin aquifers which are recharged with freshwater some 50 to 100 km to the northwest (Biggs, 1970), the water table aquifer is recharged locally by precipitation. Saltwater contamination of the unconfined aquifer probably occurs periodically as a result of severe storm tides (Winner, 1978). The average annual rainfall is approximately 105 cm in the Chincoteague area (Bolyard, 1978). Yet, the runoff of precipitation rarely occurs on the sandy soils of barrier islands (Bolyard et al., 1979; Winner, 1978). Most of the precipitation infiltrates directly into the soil whereupon it drains vertically under the force of gravity through the unsaturated zone. Once reaching the water table, subsurface water moves laterally in the direction of the water table surface slope. This drainage generally follows the land surface slope toward the interior wetland swales and ponds or toward the Bay waters that surround the Island. Discharge from Chincoteague's water table aquifer occurs by evaporation, transpiration, seepage into surface water bodies which drain interior portions of the island by channel flow, and seepage into the Bay and saltwater channels that surround Chincoteague. A schematic representation of the hydrologic cycle of a typical Holocene barrier island is shown in Figure 3.

Fluctuations in the elevation of the water table are controlled by climatic conditions and human activities on barrier islands (Kimmel and Vecchioli, 1979). The water table rises when recharge exceeds discharge and falls when the opposite condition prevails. Natural recharge of groundwater is inhibited by paving and compacting soils over large areas and by directly channeling storm waters off the island. If recharge by precipitation is sufficiently inhibited, recharge will eventually begin to occur laterally by salt water intrusion (Freeze and Cherry, 1979; Bear, 1979).

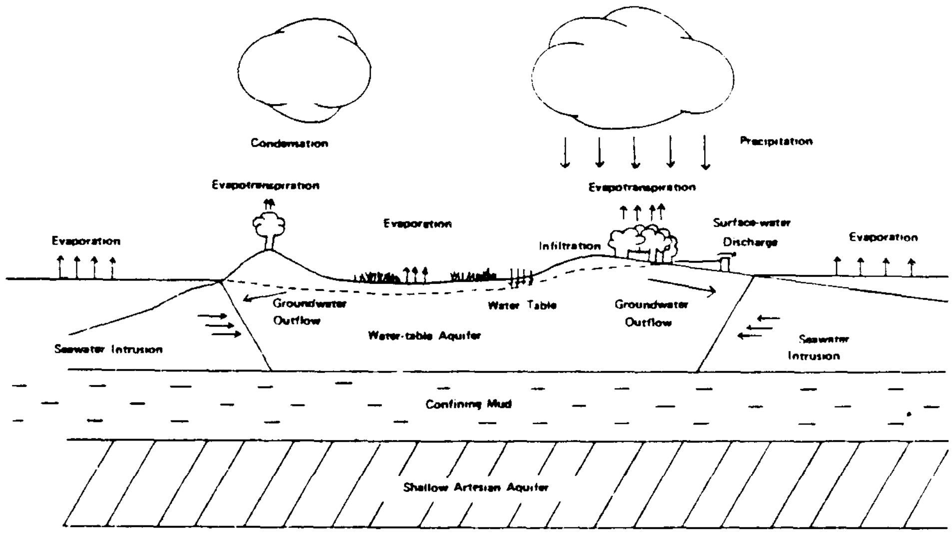

Figure 3. Hydrologic cycle of a typical Holocene barrier island (from Missimer, 1976).

1.3.2 Surface Water

Elevations on Chincoteague Island range from approximately -0.5 to +2.5 m (relative to mean sea level). As stated before the island possesses a ridge and swale topography related to its developmental history. The parallel systems of ridges and swales have bands of vegetation which correspond to the absolute elevation of the ridge tops and swale bottoms as well as the local height and variability of the water table. Lowland areas are composed of low ridges and wide swales that are seasonally or semipermanently flooded and primarily support wetland vegetation. Naturally occurring upland areas consist of higher, broader ridges and narrower swales which are characterized by less frequent incidences of flooding and a greater percentage of upland vegetation. The topography of much of the lowland area of the island has been extensively modified by grading and filling. Dredging, ditching, and road construction have also changed natural drainage patterns on the island.

Major surface drainage pathways that are relevant to this study are shown in Figure 4. Drainage is effectively divided by County road 2104 which crosses the island near the northeastern section of the town of Chincoteague. North of 2104 the wetlands drain primarily toward the jeep trail ditch. County road 2102 creates another surface drainage divide that runs lengthwise through the central portion of the island. To the west of 2102 the system is drained primarily by Fowling Gut. To the east drainage flows into Andrews Landing Gut and several smaller creek systems. The major drainage systems will be described separately below.

Historically, surface drainage into Oyster Bay and Little Oyster Bay was blocked by filling along the shorelines of these water bodies; first along County road 2104 and more recently by dredging and filling of homesites along Oyster Bay. Instead of exiting into the Oyster Bays, surface water now drains to the south into the jeep trail ditch and then to the west into Chincoteague Bay near the High School. The jeep trail ditch is permanently flooded and tidal. A small diameter culvert under County road 2101 tends to maintain a substantial head of brackish water which promotes steady drainage into Chincoteague Bay during rainy periods.

Fowling Gut is a natural, interior drainage system that runs lengthwise across the southern two-thirds of the island. In its upper reaches above Mire Pond it has been modified by channelization; culverting beneath roadways has occurred along its entire length. A 1943 U.S.G.S. topographic map and aerial photographs from the 1940's indicate that at one time Fowling Gut probably had tidal connections at both the northeast and southeast ends of the Island. The tidal connection at the southwest end of the island has been preserved through the use of

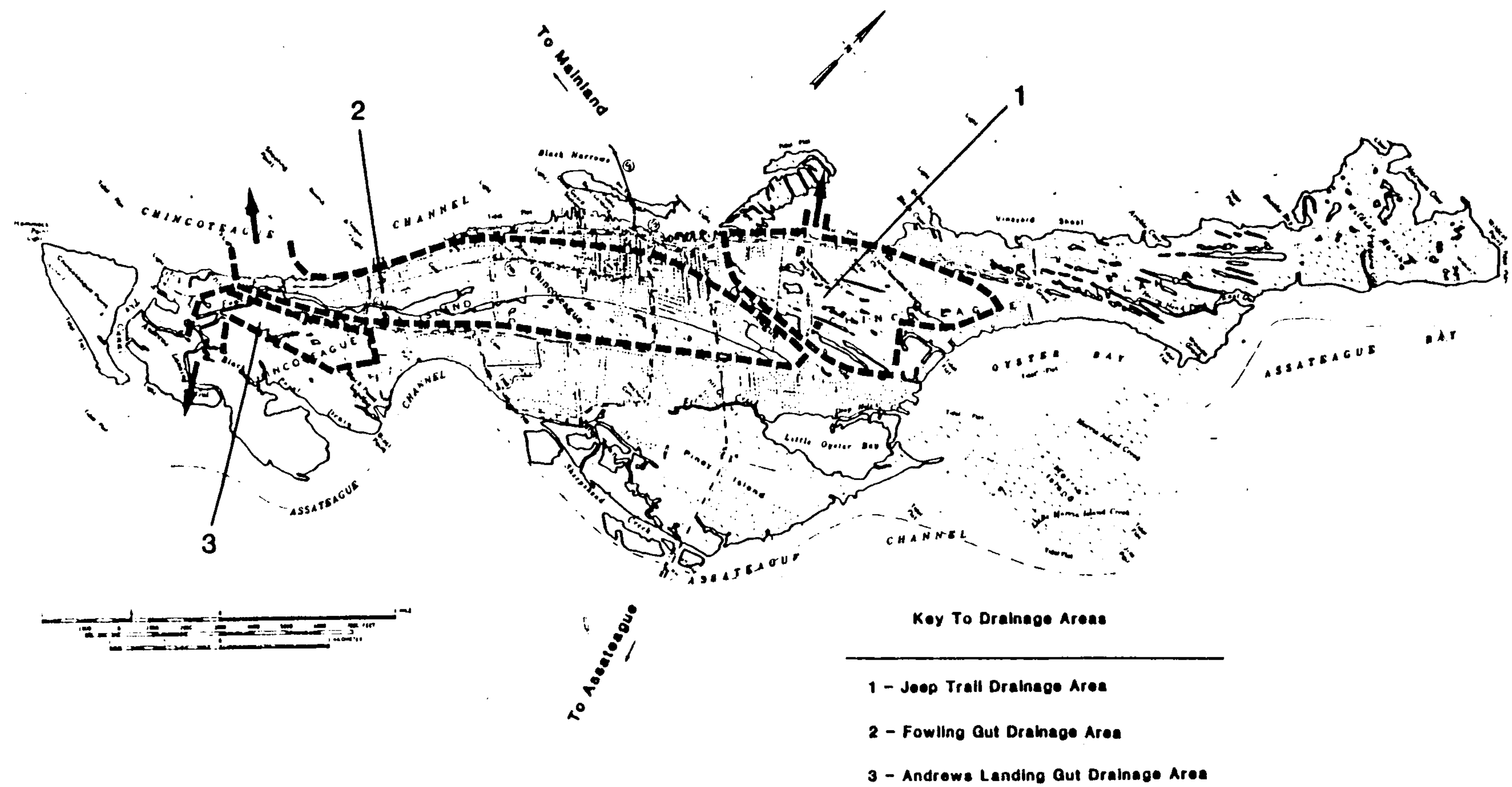

Figure 4. Major surface drainage areas on Chincoteague Island, Virginia.

culverts underneath County roads 2102, 2113, 2103, and 2126 and State road 175. However, flow has been substantially constricted by the culverts. A recent engineering study (Waterways Surveys 1985) reported that Fowling Gut exhibits tidal effects all along its length although the amplitude of tidal fluctuations at its headwaters are increasingly diminished. The timing of peaks and low tides are considerably delayed relative to the tides in Chincoteague Bay. The study also showed that the waterway responds quickly to even moderate rainfalls by collecting stormwater and shunting it over a period of days into Chincoteague Bay. It is not known whether alterations of the Fowling Gut system have increased or decreased surface drainage from the interior portions of the Island. Pavement drainage and surface channeling of stormwater by road-side ditches may promote more rapid drainage of precipitation following storms. Seasonal periodicities in the volume of water stored in the Fowling Gut system have not been studied as well.

Dredging and spoil placement at the headwaters of Andrews Landing Gut in addition to the recent development of a trailer park to the north have isolated a large section of salt marsh from surface water exchange with Fowling Gut. Recent road construction between Andrews Landing and Black Point Landing has further isolated this wetland from regular tidal exchange with Assateague Channel. Two, small-diameter culverts under the new road are flap gated to impede tidal influence and promote drainage of the marsh.

The wetlands chosen for study on Chincoteague were only a small subset of a large, interconnected, and, in many places, disturbed system of swales, seasonal ponds and ditches. Many of the wetlands are topographically isolated from surface water exchange with the jeep trail ditch, Fowling Gut, and Andrews Landing Gut during most times of the year. The sandy underlying substrate does, however, promote water exchange between the wetlands and the water table aquifer. Depending upon local topographic variation and recent climatic conditions, isolated wetlands can accept groundwater discharge from surrounding uplands or recharge the groundwater system. During extremely wet periods, overflow and redistribution of surface water to tidal channels can occur.

1.4 WETLAND ECOLOGY

1.4.1 Vegetation

The interior wetlands of Chincoteague Island exist primarily in the elongate swales between the relict beach ridges and intertidal marshes fringe the island's circumference and tidal waterways. Depending upon the proximity to Chincoteague Bay and the presence or absence of a tidal connection, salinities in these wetlands range from almost totally freshwater to fully marine. Based upon the classification of Cowardin et al. (1979), there are five general wetland types present on Chincoteague Island; (1) estuarine emergent, (2) estuarine scrub-shrub, (3) palustrine emergent, (4) palustrine scrub-shrub, and (5) palustrine forested.

The ends of the swales which abut Chincoteague Bay and most of the wetland margins of Fowling Gut are dominated by estuarine emergents such as Spartina alterniflora, Spartina patens, and Distichlis spicata. Two wetland shrubs dominate the vegetation in more elevated areas: marsh elder (Iva frutescens) and salt bush (Baccharis halimifolia). Wax myrtle (Myrica cerifera) is present at the wetland-upland transition.

Surface water salinities decrease markedly as the swales are traversed toward the interior of the island. The wetland plant communities, in turn, become increasingly dominated by brackish and freshwater species including various sedges (Scirpus spp.), cattails (Typha spp.), smartweeds (Polygonum spp.), water dock (Rumex verticillatus), marsh hibiscus (Hibiscus moscheutos) and seashore mallow (Kosteletzkya virginica). Marsh elder dominates the higher, shrub zones in these palustrine wetlands. Hardwoods that can withstand seasonal flooding have attained dominance in some wetlands. Red maple (Acer rubrum) is the most common tree species in these situations although slippery elm (Ulmus rubra), sweet gum (Liquidambar styraciflua), and water oak (Quercus nigra) are also important constituents in the overstory of well developed, palustrine forested wetlands. Areas which have been filled or otherwise disrupted are usually covered with a thick stand of reed grass (Phragmites australis).

1.4.2 Fish Communities

Fish are present in Chincoteague's wetlands only where an open connection exists between the swales and the estuary. Where connections are absent, there is a lack of fish communities in these wetlands, which may experience a complete drying up of the swale pools during extended drought. Where surface water connections to the estuary exist, the fish communities are dominated by typical estuarine forage fishes such as killifishes (Fundulus spp.), and sheepshead minnow (Cyprinodon variegatus), and juveniles of commercially important species such as bluefish (Pomatomus saltartix), menhaden (Brevoortia tyrannus), spot (Leiostomus xanthurus), and Atlantic croaker (Micropogonias undulatus). Estuarine invertebrates such as blue crabs (Callinectes sapidus) and grass shrimp (Paleomentes pugio) are also present. Dense concentrations of marine and estuarine fish use the marshes and tidal creeks of estuarine wetlands as primary nursery habitats (McHugh, 1966; Cain and Dean, 1976; Weinstein, 1979; Bozeman and Dean, 1980; Rozas and Hackney, 1983). A wetland system the size of Chincoteague, however, does not have sufficient freshwater discharges like a riverine system's to support anadromous species such as shad and striped bass.

1.4.3 Avian Communities

Chincoteague Island is situated within the Atlantic Coast Flyway, a migratory bird corridor which is heavily used by a wide range of avian groups. Depending on the time of year, many different species of birds may be observed using the wetland resources of Chincoteague Island for feeding and resting. Very large populations of swans, geese, and dabbling ducks have been reported for the Chincoteague vicinity along with smaller numbers of diving and sea ducks (Odum et al., 1984). The extent of local use is controlled by the size of the wetland and the types of food sources present (particularly freshwater plants). Plants of particular importance to waterfowl include *Scirpus* spp., *Polygonum* spp., and *Echinochloa walteri*, all of which are abundant on Chincoteague. Herons, egrets, and other wading birds are common summer inhabitants of Chincoteague's wetlands. They forage primarily in estuarine, emergent wetlands for their preferred diet of small fish. In addition, a large number of seed-eating birds such as blackbirds, and insectivorious birds such as flycatchers, are known to use palustrine wetlands similar to those on Chincoteague (Odum et al., 1984).